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Electrification of HGVs

Seminar at Warwick University

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1 February 2023

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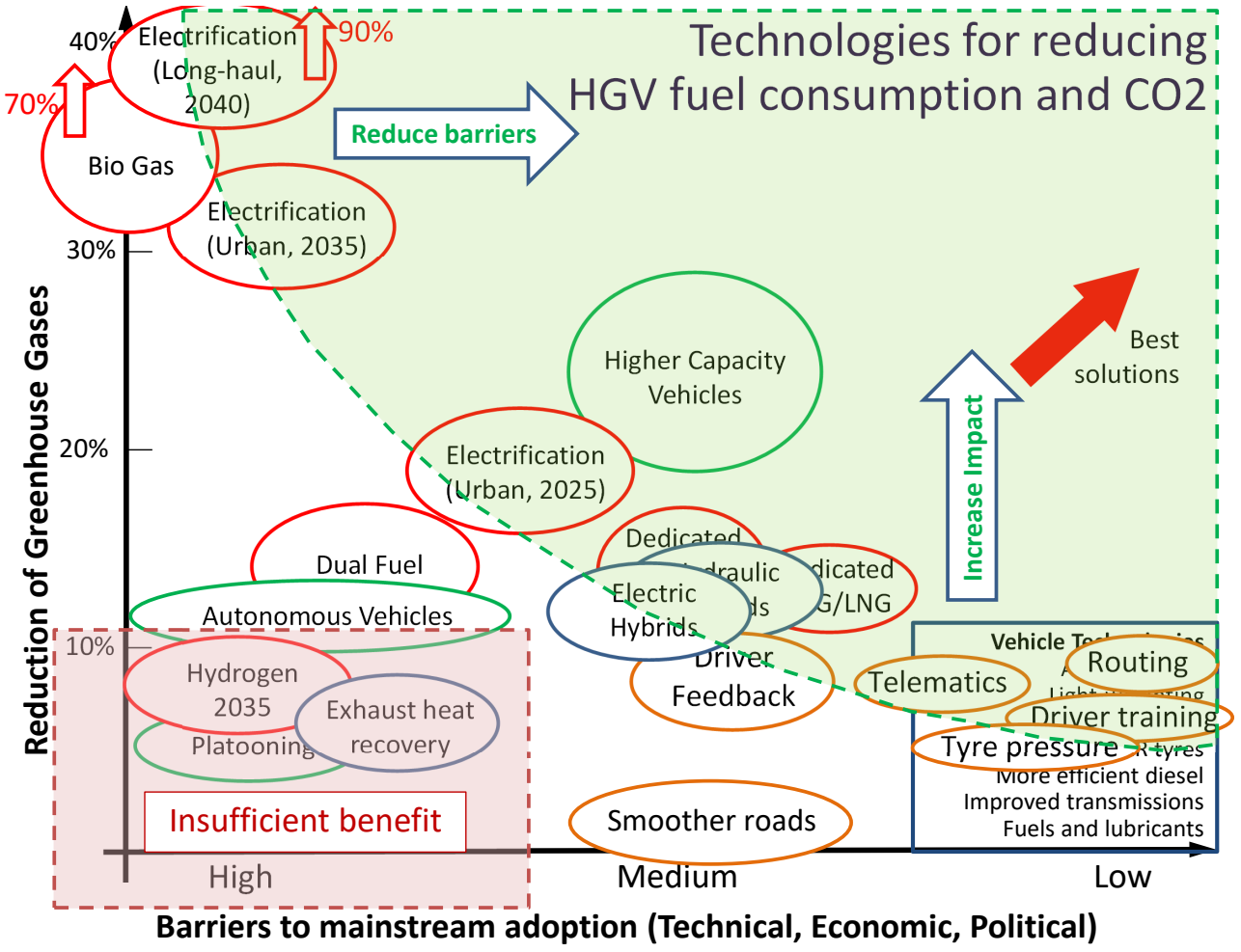
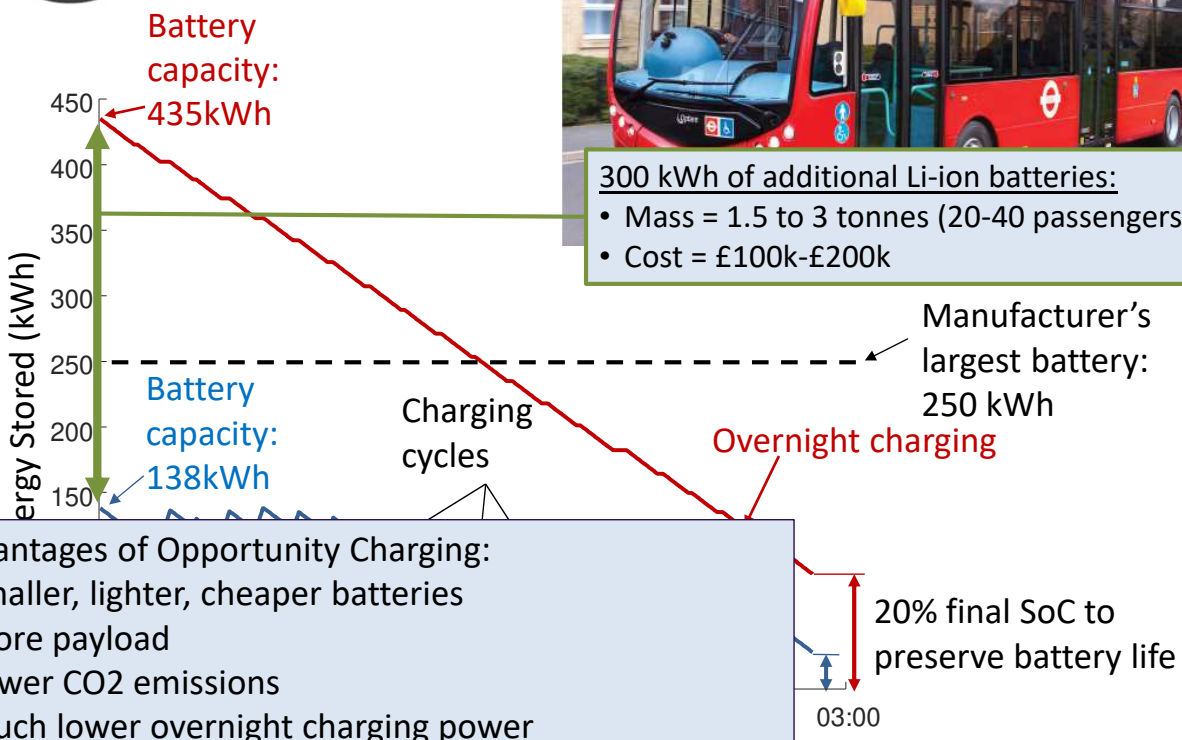


Urban Freight

- **Rolling-out now…**
- **Building technologies and supply chains for higher capacity BEVs**

Opportunity Charging

300 kWh of additional Li-ion batteries:
- Mass = 1.5 to 3 tonnes (20-40 passengers)
- Cost = £100k-£200k



Advantages of Opportunity Charging:
- Smaller, lighter, cheaper batteries
- More payload
- Lower CO2 emissions
- Much lower overnight charging power

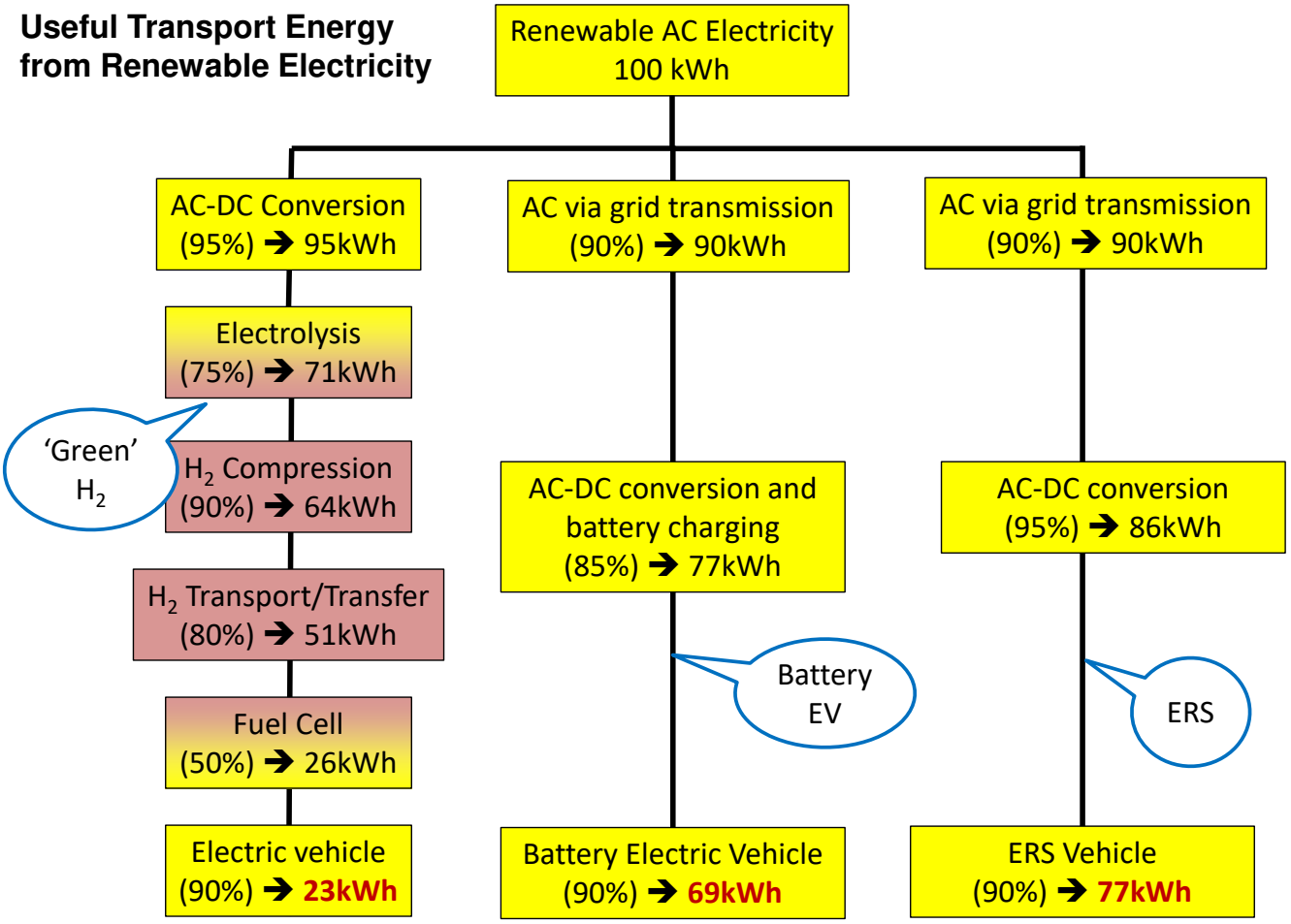
➔ Electrification is about the charging not the vehicles!

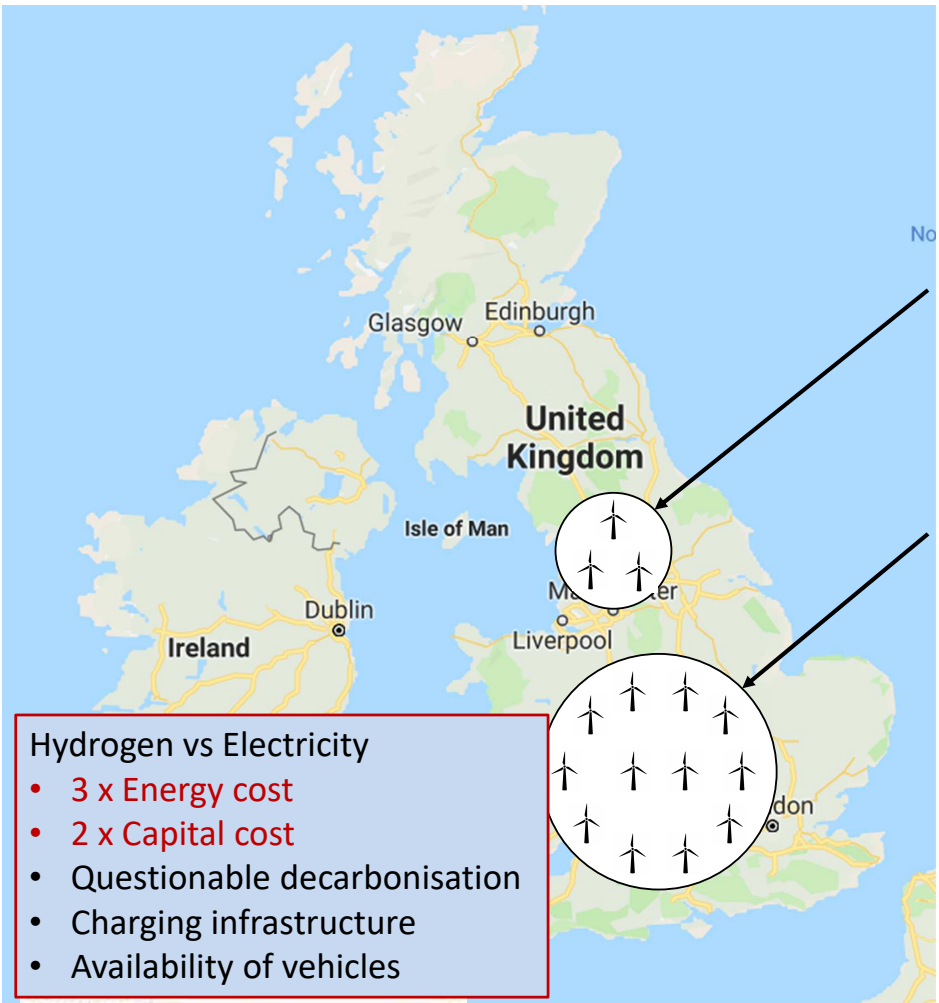
Previous Trials of Opportunity Charging

- Hamburg, Germany
- Innovation Line 109
- 4 X 300 kW conductive chargers

- Milton Keynes, UK
- Route 7
- 2 X 120 kW wireless chargers

Useful Transport Energy from Renewable Electricity





Land areas for electrification of UK Road Freight

ERS:

- 10.6 GW
- 3,500 wind turbines
- Land Area=5,300 km^2

'Green' Hydrogen:

- 35.6 GW
  (31 GW = UK average)
- 12,000 wind turbines
- Land Area=18,000 km^2

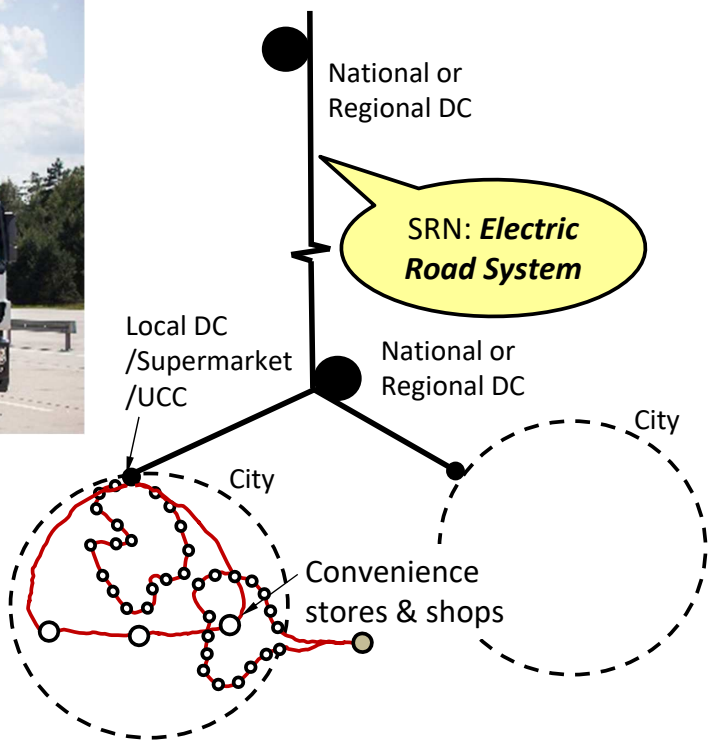
Hydrogen vs Electricity

- 3 x Energy cost
- 2 x Capital cost
- Questionable decarbonisation
- Charging infrastructure
- Availability of vehicles

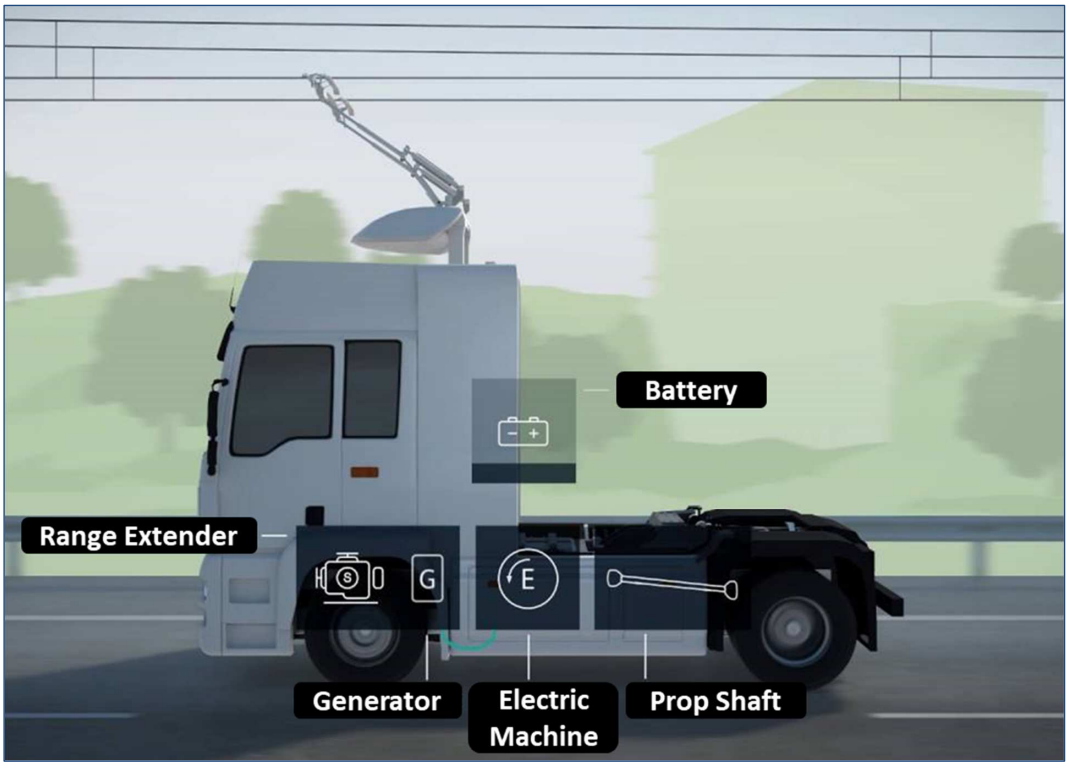
Assumptions:

1. UK freight: 189b t.km per year
2. 0.19 kWh/t.km (44t), LF=0.75
3. Efficiencies:
   - 0.77 ERS
   - 0.23 H_2
4. Turbine power: 3MW
5. Wind power density: 2 W/m^2

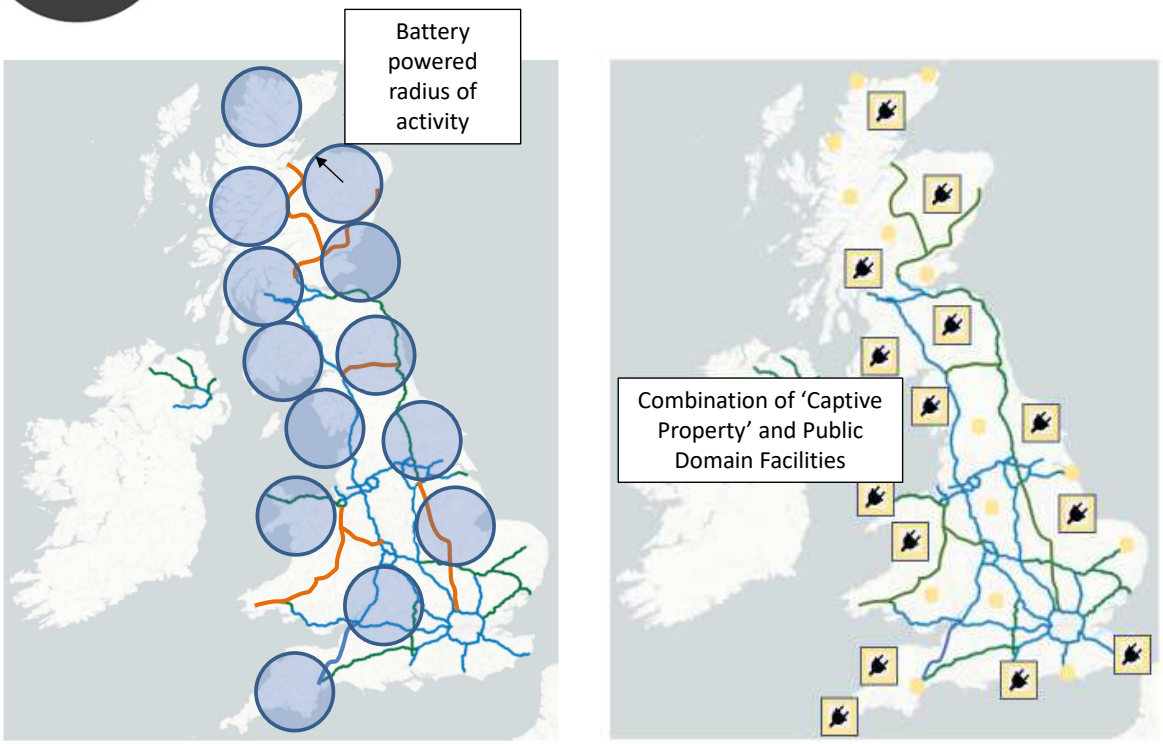
Electrification of Long Haul



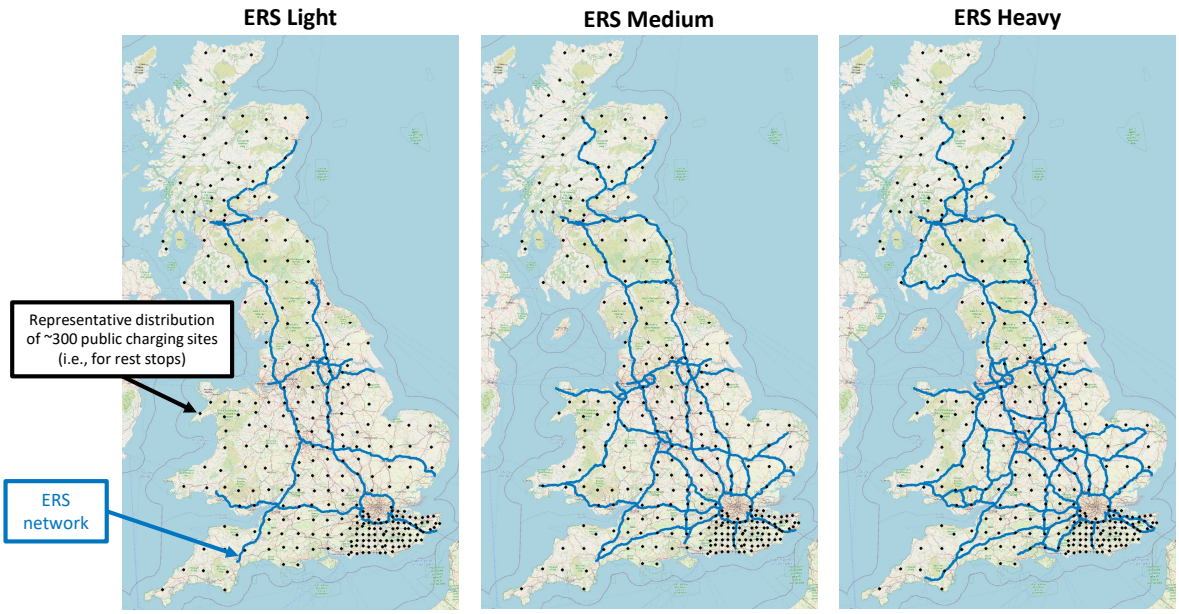
eHighway Vehicle (Siemens, 2020)



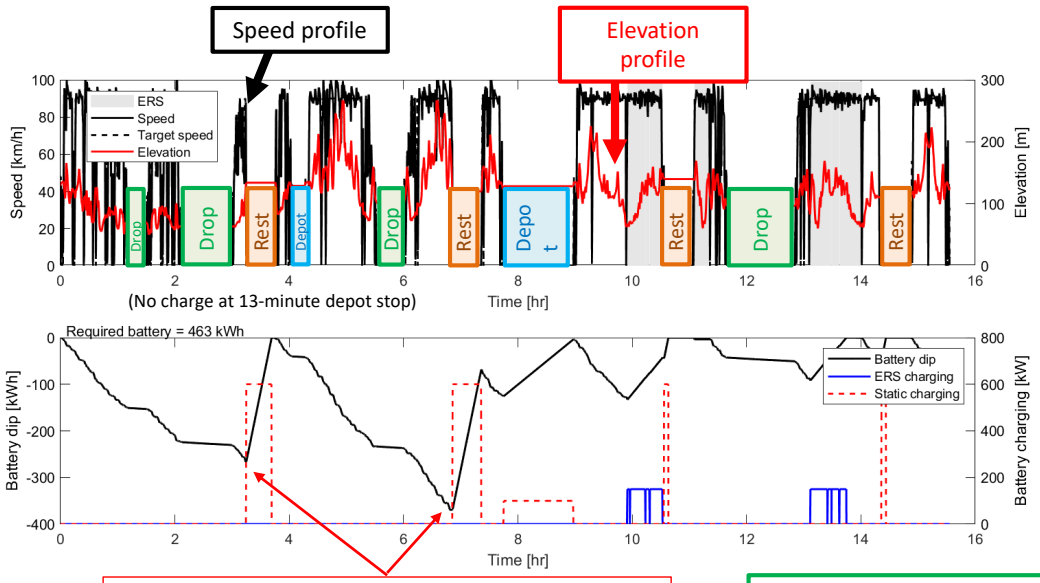
The Network Design Challenge



ERS scenarios



Scenario: ERS Light + BEV rest stop charging

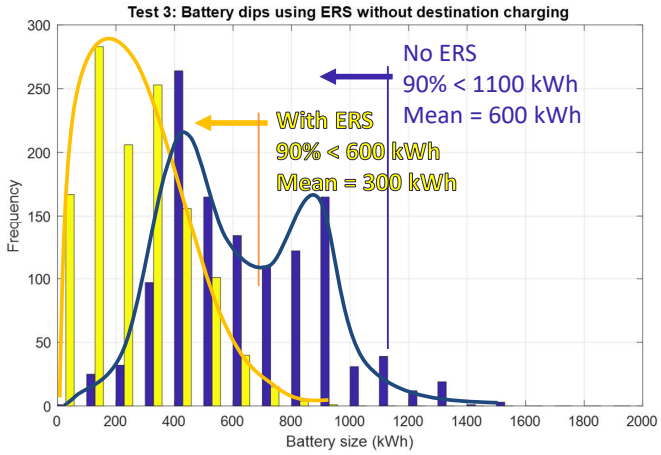


Logistics journey simulations

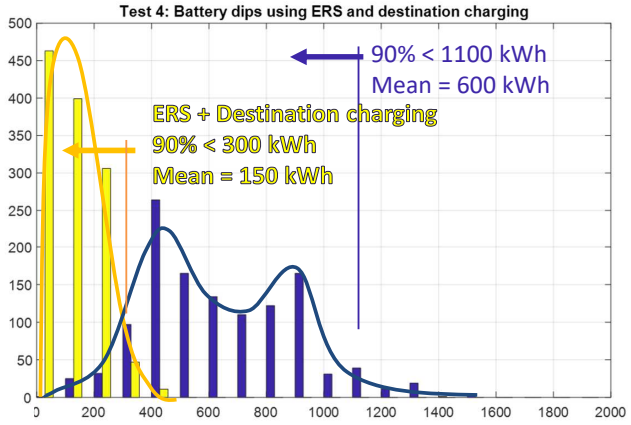
Operator H	Required battery capacity (kWh)			
	ERS topography			
	None	Lite	Medium	Heavy
No static charging	1666			
Charge at drop-off sites (600 kW)	397			
Charge at public rest stops (600 kW)	794			
Charge at both drop-offs/rest stops	388			

No ERS

Batteries for challenging journeys

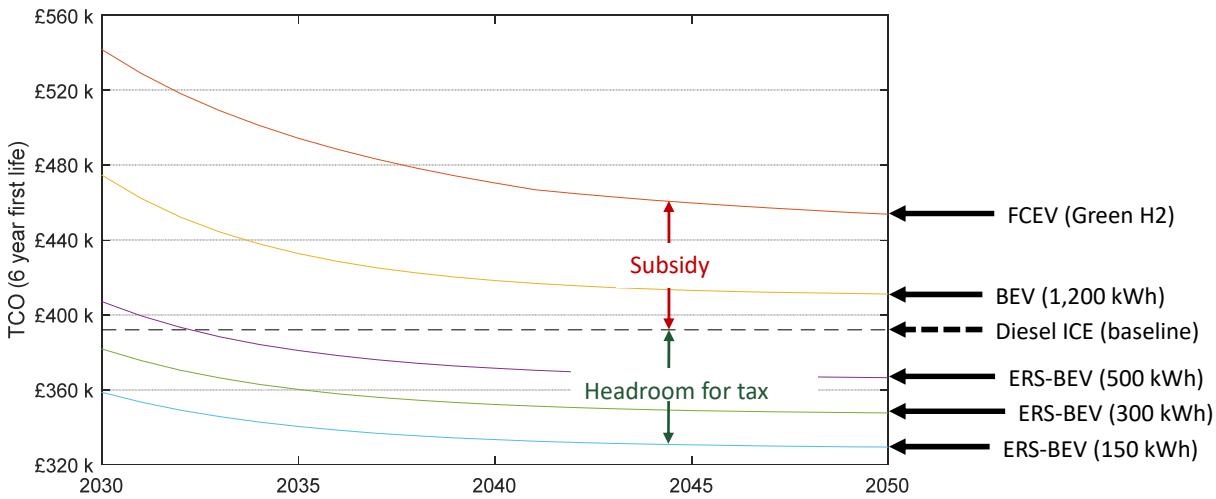


Battery size with and without 'Light' ERS



Battery sizes with 'Light' ERS and destination charging

Total Cost of Ownership (TCO)



Conclusions

1. **Electrification:**
   - **..is all about the charging not the vehicles**
   - **... fitting the charging into the logistics day**
2. **Urban: battery EVs + opportunity charging**
3. **Long-Haul : BEVs with ERS**
4. **Hydrogen: Too expensive.**
5. **Modular Electric logistics can be made to work ➔the future!**